



The Effects of California Forest and Rangeland Regulations and Programs on Greenhouse Gas Goals

Interagency Forest Working Group

Role of the Forest Sector in Greenhouse Gas Reduction

California's forest sector is the only economic sector in the state's greenhouse gas (GHG) inventory that, on net, absorbs and stores ("sequesters") more greenhouse gases than it emits.¹ The California Global Warming Solutions Act of 2006² (commonly known as AB 32) required California GHG emissions in 2020 to be no higher than they were in 1990, and directed the Air Resources Board (ARB) to approve a scoping plan to achieve that target. The Scoping Plan³ describes dozens of measures across economic sectors with expected emissions reductions for each. The forest sector target is to have a net sequestration of 5 million metric tons of carbon dioxide equivalents in 2020, maintaining current sequestration levels.

In 1973, The Z'berg-Nejedley Forest Practice Act⁴ established the Board of Forestry and Fire Protection (BOF) and required it to adopt rules and regulations to, among other things, "...assure the continuous growing and harvesting of commercial forest tree species and to protect the soil, air, fish and wildlife, and water resources, including but, not limited to, streams, lakes and estuaries." This statutory obligation extends not only to timberlands, but all forestlands. These forestlands include a large proportion of rangelands as well. The BOF's regulations have been designed to enhance the multiple values articulated in the Act. Assembly Bill 1504 added sequestration of carbon dioxide to the list of "public needs" in the Z'berg-Nejedley Forest Practice Act (FPA), and stated a legislative declaration that "The board [of Forestry and Fire Protection], the department [of Forestry and Fire Protection], and the State Air Resources Board should strive to go beyond the status quo sequestration rate and ensure that their policies and regulations reflect the unique role forests play in combating climate change."⁵

Establishment of the Interagency Forest Working Group

In 2009, the Board of Forestry and Fire Protection (BOF) established the Interagency Forestry Working Group on Climate Change (IFWG) to provide advice and

¹ "California Greenhouse Gas Inventory for 2000-2008 — by Category as Defined in the Scoping Plan," California Air Resources Board, http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_00-08_2010-05-12.pdf (Accessed September 20, 2011).

³ Division 25.5 of the California Health and Safety Code

³ "AB 32 Scoping Plan," California Air Resources Board, <http://arb.ca.gov/cc/scopingplan/scopingplan.htm> (Accessed September 20, 2011).

⁴ Division 4, Chapter 8 of the California Public Resources Code

⁵ [14 CCR § 4512.5](#).

http://www.fire.ca.gov/resource_mgt/downloads/2011_FP_Rulebook_with_Diagrams_with_Tech_Rule_No_1.pdf

recommendations on achieving the Scoping Plan target for the forestry sector, and other climate and energy related information, research and policy needs, strategies, and recommendations.⁶ The California Natural Resources Agency (CNRA) and BOF serve as co-chairs. Members include the California Environmental Protection Agency (Cal/EPA), Department of Forestry and Fire Protection (CAL FIRE), ARB, Energy Commission (CEC), Department of Fish and Game (DFG), Department of Water Resources (DWR), and the United States Forest Service (USFS).

IFWG established the following tasks:

- 1) Improve the California GHG inventory for the forest sector
- 2) Evaluate adequacy of existing forest regulations and programs for achieving Scoping Plan forest sector GHG targets
- 3) Define biomass sustainability for biofuel utilization for the State's Low Carbon Fuel Standard⁷ (LCFS) and Alternative and Renewable Fuel and Vehicle Technology⁸ (AB 118) programs
- 4) Develop and promote incentives for private and public landowners to increase and maintain carbon stocks on their lands, and
- 5) Identify educational opportunities about climate change for forest landowners.

This report describes activities for the second task (Task 2) above. Information about IFWG, including meetings and other work plans, is available online.⁹

The Task #2 Objective (Appendix A) was to determine:

- 1) the effectiveness of the State's existing forest and rangeland regulations and related programs on meeting the State's GHG goals,
- 2) whether simple adjustments to existing regulations programs may be needed ,
- 3) Whether more significant regulatory action is needed to ensure attainment of the forest sector's GHG Scoping Plan targets.

The Task 2 Work Plan developed with input from stakeholders established the following deliverables:

- 1) An evaluation, as feasible, of the capacity of existing forestry and regulatory framework and programs to ensure achievement of Scoping Plan targets,
- 2) List of concerns and identified regulatory and program gaps,
- 3) Recommendations, if needed, for amending regulations or improving program practices or procedures to ensure that CA forests achieve the Scoping Plan Target,

⁶ "2009 Charter: Interagency Forestry Working Group on Climate Change," Board of Forestry and Fire Protection, http://www.bof.fire.ca.gov/board_committees/interagency_forestry_working_group/mission_and_goals/charter/ifwg_charter_final4-7-09.pdf (September 20, 2011).

⁷ Low Carbon Fuel Standard Program, California Air Resources Board website: <http://www.arb.ca.gov/fuels/lcfs/lcfs.htm>

⁸ Alternative and Renewable Fuel and Vehicle Technology Program, California Energy Commission website: <http://www.energy.ca.gov/altfuels/>

⁹ CAT Forest Group / Interagency Forestry Working Group website: <http://www.climatechange.ca.gov/forestry/index.html> (Accessed November 17, 2011).

- 4) Recommendations, as needed, for longer term analysis, research, demonstration or monitoring of regulatory and other program effects on carbon sustainability

IFWG Task 2 Implementation

The objective of Task 2 is to “determine the effect of the State’s existing forest and rangeland regulations (i.e., Sustained Yield Plans, Non Timber Management Plans, wildlife, water quality, erosion protection, etc.) and related programs on meeting the state’s GHG goals, whether simple adjustments are needed, or whether more significant action is needed.”¹⁰ CAL FIRE and the USFS assumed the lead for Task 2.

CAL FIRE and the USFS developed and revised a Task 2 work plan with input from IFWG and stakeholders (Appendix A). Task 2 implementation took into consideration coordination with other IFWG tasks. For example, the first Task 2 activity undertaken was a workshop on state and federal forestry laws, regulations and programs so that CEC and ARB would have this information in a timely manner for implementing Task 3 (defining sustainable biomass utilization for the LCFS and AB 118 programs). It also considered implementation of Task 2 work plan activities in light of other events that unfolded outside of IFWG during this period, such as workshops, symposia and research.

Task 2 Workshop to Review Adequacy of Current Policy and Regulations

IFWG held a workshop held on June 22, 2010 at the Wildland Fire Training and Conference Center in McClellan, CA. The agenda and presentations were designed to provide an overview of how state and federal laws, regulations and programs state address carbon sequestration for purposes of addressing IFWG Task 2 and also Task 3 (sustainable biomass utilization).¹¹ Presentations included a review of maximum sustained productivity (MSP) rules which require balancing harvest and growth to maintain forest timber inventory and, by implication, carbon stocks.¹² Other regulations discussed were timberland conversion; GHG analysis; environmental protection of watersheds, soils and biological resources; and a new Modified Timber Harvest Plan (THP) for Fuels Management which was developed in close cooperation with Department of Fish and Game and other agencies to ensure environmental protection and sustainability. The USFS gave presentations on planning and review processes at the regional, forest and project levels. Other state agencies addressed

¹⁰ IFWG Task 2 Work Plan, Appendix A and http://www.climatechange.ca.gov/climate_action_team/forestry/meetings/2010-03-01_meeting/2010-03-09_CALFIRE_IFWG_Task_2_DRAFT_WORKPLAN.pdf (Accessed December 14, 2011).

¹¹ [IFWG Workshop to Address Task 2 and Task 3 Objectives](http://www.climatechange.ca.gov/forestry/meetings/index.html). June 22, 2010. CA Climate Change Portal. <http://www.climatechange.ca.gov/forestry/meetings/index.html>

¹² [14 CCR, § 913.10 and 913.11](http://www.fire.ca.gov/resource_mgt/downloads/2011_FP_Rulebook_with_Diagrams_with_Tech_Rule_No_1.pdf). http://www.fire.ca.gov/resource_mgt/downloads/2011_FP_Rulebook_with_Diagrams_with_Tech_Rule_No_1.pdf

environmental and health considerations related to timber harvest, fuels reduction, and biomass-to-energy issues. Landowners described planning and economic aspects of timber harvest.

The primary concern expressed at workshop Q&A sessions was that current regulations would not be adequate to deal with anticipated increases in biomass utilization for energy, i.e., that they might fail to ensure sustainability for carbon and other ecosystem values.

Stakeholders raised concerns about whether permitting exemptions for fire hazards or dead and dying trees provide adequate protection and GHG assurances. Questions were raised about staffing in various agencies to ensure adequate review of biomass projects if activity increases, especially for fish and wildlife impacts. Other concerns included air quality and health effects of local biomass plant emissions, and whether the FPA covers biomass operations on non-commercial timberland.

Other speakers and participants expressed concerns about long-term sustainability of forest carbon sequestration without additional forest thinnings and biomass removal. This was described in the context of climate change effects on disturbance regimes.

Recent Regulatory Changes to Address GHG Forestry Impacts

California statutes and codes have been strengthened in a variety of ways to address climate change and reduce greenhouse gas emissions. The California Environmental Quality Act (CEQA) Guidelines were amended effective March 18, 2010 through addition of 14 CCR 15064.4. This new CEQA guideline requires lead agencies to consider the significance of potential impacts from projects and develop models or methodologies for quantifying greenhouse gas emissions. The requirements of this CEQA guideline are applicable to harvest documents approved by CAL FIRE and CAL FIRE requires quantification of GHG emissions from proposed timber operations for each project which it reviews and approves.

As a result of these changes, timber harvest proponents subject to State regulations must analyze GHG emissions when applying to CAL FIRE for permits. To assist landowners in compliance with this CEQA guideline, CAL FIRE developed an on-line GHG calculator that can be used to calculate sequestration and emissions associated with long term-timber harvest management planning¹³. CAL FIRE solicited and received comments and recommendations for improving this tool from agencies, academia and practicing foresters. CAL FIRE is making changes to the calculator to address those suggestions

¹³ [CAL FIRE website, Forest Practices, Memorandums for THP GHG Calculator and User Guide](http://www.fire.ca.gov/resource_mgt/resource_mgt_forestpractice_pubsmemos_memos.php)
http://www.fire.ca.gov/resource_mgt/resource_mgt_forestpractice_pubsmemos_memos.php

The Forest Practices Act was amended by the legislature effective January 1, 2011 to recognize role of forest carbon sequestration in meeting scoping plan goals. Changes included addition of PRC 4512.5 (a)-(e), PRC 4513 and PRC 4551. These additions to the Forest Practice Act require the BOF to ensure that rules and regulations that govern the harvesting of commercial forests meet AB 32 greenhouse gas reduction goals. Section 4512.5 incorporates findings and declarations relative to the important role of the state's forests in meeting the goals of the AB 32 Scoping Plan. Section 4513 adds carbon dioxide sequestration to the Forest Practice Intent assurance language and Section 4551(b) requires the Board to consider the capacity of forest resources to meet the Scoping Plan forestry GHG target and to fund research and technical studies with funds appropriated by the Legislature from the collection of AB 32 emissions fees.

Timber harvest permit exemptions for removal of dead and dying trees, removal of woody debris and slash, harvesting of trees for fire prevention purposes, and defensible space within 150' of structures do not require Timber Harvest Permits (THPs)¹⁴. CAL FIRE does not believe that these projects are likely to significantly impact forest sequestration rates, however, because operations conducted under exemptions are subject to limitations designed to ensure minimal environmental impact.

Reforestation and Urban Forestry Programs Contributing to Sequestration

Federal, state and private reforestation programs and activities can help maintain or increase sequestration on public and private forest lands. For the AB 32 Scoping Plan, CAL FIRE analyzed a strategy for reforesting an additional 56,000 acres of forest and woodland acres, which could enhance sequestration by 6 MMT annually¹⁵ in 2030 and over 20 MMT/year in 2050.¹⁶ Reforestation would be accomplished through federal and state land management, GHG offset projects, CEQA mitigation measures, and public grants funds, such as CAL FIRE's Forest Improvement Program (CFIP).

CFIP provides cost share assistance to local, state and private landowners for reforestation. These funds help restore lands deforested by fires, insects and pests, and historical land conversions, but cannot be used to meet regulatory requirements for restocking after commercial timber harvests. Funding has been negligible for the last six years, with CFIP reforesting an average of about 250 acres per year.

The USFS, on the other hand, has increased its reforestation from a five year annual average of 9,000 acres to over 25,000 acres per year during the last three years¹⁷. Reforestation is commonly performed in areas that have experienced

¹⁴ [14 CCR, § 1038.](#)

¹⁵ CAL FIRE AB 32 analyses, developed by Winrock International and adapted by Tim Robards.

¹⁶ [AB 32 Scoping Plan, Appendices, Volume 1, p. C-167.](#)

¹⁷ Michael Landrum, USFS, personal communication, 11/22/11.

high intensity fires or severe insect mortality. Based on a CAL FIRE analyses done for the Scoping Plan, this could yield over 2 MMT in 2030 and almost 7 MMT in 2050.¹⁸

The methodology used for estimating reforestation GHG benefits for the Scoping Plan assumed significant upfront emissions from brush removal for site preparation. Recent discussions with state and federal programs indicate that projects are more often implemented on recent burns or disturbances, so brush removal is not required. These treatments would therefore result in fewer emissions and would produce GHG benefits much sooner.

Urban forestry projects, implemented with public and private funds, also sequester CO₂ and mitigate GHG emissions associated with new developments and older urban areas. For the AB 32 Scoping Plan, CAL FIRE estimated that an additional 1.5 to 2 million urban trees planted through the Urban Forestry Program from 2008 through 2010 could sequester 0.1 MMT /yr by 2020 and about 0.4 MMT per year in 2050. CAL FIRE's tree planting average has remained at about 10,000 trees per year, however, producing marginal GHG benefits¹⁹. Urban forests also provide important climate adaptation benefits, including reduction of heat health effects in cities.

Programs to prevent forestland conversion through land purchases and conservation easements could also help maintain sequestration. This includes programs such as state and federal Forest Legacy programs, the Wildlife Conservation Board's Forest Conservation and Oak Woodland Conservation Program, and other actions by state and private conservancies. The WCB has conserved 60,000 acres during the past five years. CAL FIRE's Forest Legacy Program has conserved about 3,000 acres per year for the last 3 years, producing slightly under 0.1 MMT GHG benefits per year²⁰. CAL FIRE has not been tracking GHG conservation benefits of other agencies.

Forest sequestration Rates and Trends-Relationship of Task 2 to Task 1 GHG and Forest Inventories and Analyses

Step 2 of the IFWG Task 2 Work Plan called for a review of latest information on current forest sequestration rates and trends. This step was undertaken with the objective to determine if trends in current harvesting under the current regulatory and program authorities for federal land managers and state regulatory agencies indicate that trends in carbon stock removals harvest levels are exceeding sequestration rates. The evaluation conducted as part of the Task 2 Work Plan was conducted recognizing that Task #1 Inventory would proceed on a complimentary track but would not likely be completed until 2014.

¹⁸ CAL FIRE AB 32 analyses, developed by Winrock International and adapted by Tim Robards.

¹⁹ „State Agency Greenhouse Gas Reduction Report Cards», [California Climate Change Portal](http://www.climatechange.ca.gov/Portals/0/State%20Agency%20Greenhouse%20Gas%20Reduction%20Report%20Cards.pdf), 2008-2011.

²⁰ Op.cit., State Agency Greenhouse Gas Reduction Report Card. 2008-2011.

For purposes of assessing carbon sequestration trends under timber harvesting regimes conducted under existing regulations, the Task 2 workgroup evaluated a number of existing information sources but placed a great deal of weight on the data generated through the Forest Inventory Analysis (FIA) program utilized by the United States Forest Service to develop inventory estimates.. The U.S. Forest Service FIA is a long-term national inventory for public and private forest lands.

With respect to sources of forest carbon emissions, USFS analysis of more recent FIA data shows that on national forest lands in California ten times more biomass was lost in the last decade to wildfires and other disturbances than to harvest.²¹ Fire incidence on reserved USFS land (wilderness with little to no active management) was three times higher than unreserved lands, and much of gross sequestration on undisturbed areas was offset by disturbances (primarily wildfire).

In June 2010 CAL FIRE completed its statutorily mandated Forest and Rangelands Assessment (FRAP Assessment).²² Using the most recent FIA data, it projected long-term growth, mortality and harvest; incorporated ARB wildfire emissions analyses; and took wood products into account. This analysis estimated that California forests are sequestering 30 MMT CO₂e per year on net (see Appendix B). The report had extensive public outreach and workshops to solicit input and comments.

The FRAP assessment also reports a continuous decrease in timber harvest over the last two decades (from 4.5 billion board feet in 1989 to less than 1.5 billion board feet in 2009) and increasing wildfire acreage burned by wildfires over about the same period. This includes a dramatic increase in conifer forest burned.

Forest Growth and Disturbance Trends and Potential Climate Change Effects

Forest scientists and managers continue to examine current forest conditions and trends, and consider how these might interact with climate change. In 2010, the USFS hosted the Pre- and Post-Fire Symposium to share information on fire science, ecology and management²³. Speakers described increasing wildfire acreage, severity and impacts, the need for active management to reduce increasing hazards and risks, and measures for mitigating impacts from fuel treatments.

²¹ Jeremy Fried, USFS, PNW. Personal communication, Paper in progress.

²² CAL FIRE. California's Forests and Rangelands: 2010 Assessment,". CAL FIRE. 2010.

²³ [Pre- and Post-Wildfire Conference. February 2010. Website](http://ucanr.org/sites/Prepostwildfire/). Accessed 11/30/11.

<http://ucanr.org/sites/Prepostwildfire/>

Goines and Nechodom (2009) modeled growth and mortality on USFS lands for various management scenarios, finding that carbon stocks and net sequestration increased until mid-century under business-as-usual management, after which emissions exceeded sequestration. They attributed these trends to culmination of forest growth and increased levels of disturbance.²⁴ However, they predicted that full implementation of existing Land Management Plans (which would require additional resources) would stabilize net sequestration.

Climate scientists have examined potential climate change effects on forest growth and forest disturbance. Lenihan et. al (2006) predict increased primary production under at midcentury under three different climate scenarios, but decreased cumulative production (sequestration minus decomposition and fire consumption) by 2100 under dry climate scenarios, with up to 30-40% loss of total live woody carbon.²⁵ Westerling et. al (2009) predict increases in wildfire under multiple climate scenarios, with 57-169% increases by 2085.²⁶ Battles et. al, (2009) predict net increased production in pine plantation under all climate models and scenarios by the end of the century.²⁷

CAL FIRE (2010) analyzed potential risks to carbon stocks from climate change, fire, insects and disease and drought.²⁸ By 2100 carbon stocks show 9% and 22% declines. CAL FIRE also identified 21.3 million acres of high priority landscapes for reducing risks of ecosystem damage from wildfires, with largest concentrations in Klamath/North Coast, Sierra, Modoc bioregions and South Coast (descending order).²⁹

Bioenergy, Land Conversion, and Other Considerations

Other risks to the role of forests in sequestration and climate mitigation include new demands and markets for biomass primarily as feedstocks for production of electricity and biofuels. In 2010, the H. John Heinz III Center for Science, Economics and the Environment and the Pinchot Institute for Conservation convened a workshop in California as part of a national dialogue about ensuring forest sustainability and consistency with ecosystem restoration, sustainable economic development and GHG reduction goals in the development of wood

²⁴ [Goines and Nechodom. "National Forest Carbon Inventory Scenarios for the Pacific Southwest Region \(California\)." 2009 USFS.](http://www.fs.fed.us/r5/climate/carboninventoryassessment/assessment201007.pdf)

<http://www.fs.fed.us/r5/climate/carboninventoryassessment/assessment201007.pdf>

²⁵ Lenihan, et. al. The Response of Vegetation Distribution, Ecosystem Productivity, and Fire in California to Future Climate Scenarios Simulated by the MC1 Dynamic Vegetation Model. 2006. CEC-500-2005-191-SF. <http://www.energy.ca.gov/2005publications/CEC-500-2005-191/CEC-500-2005-191-SF.PDF>

²⁶ Westerling et. al. Climate Change, Growth and California Wildfire. 2009. CEC-500-2009-046-F <http://www.energy.ca.gov/2009publications/CEC-500-2009-046/CEC-500-2009-046-F.PDF>

²⁷ Battles et. al. Projecting Climate Change Impacts on Forest Growth and Yield for California's Sierran Mixed Conifer Forests. 2009. CEC-500-2009-047-F

<http://www.energy.ca.gov/2009publications/CEC-500-2009-047/CEC-500-2009-047-F.PDF>

²⁸ Op. cit., CAL FIRE. 2010. Chapter 3.7.

²⁹ Op. cit. CAL FIRE. 2010. Chapter 2.1.

bioenergy in the United States.³⁰ Some participants felt that forest practice acts in Pacific states are sufficient to address impacts, while others thought they should be examined for potential deficiencies and consistency with other resource and energy policies. Findings recognized that significant areas of federal land are at risk to fire and insects, and recommendations included the need for better assessments of supply and demand, science-based policies, standards and guidelines; uniform and flexible federal policies; and policies that support distributed and “appropriately scaled” approaches which provide socio-economic benefits such as employment in natural resource- based industries and provide high levels of efficiency.³¹

CAL FIRE and the USFS are working with a wide range of stakeholders to promote the utilization of woody materials from fuel reduction and forest restoration treatments based, especially for development of community-scale facilities (under 20 MW). This collaboration is based on the importance of co-benefits such as reduced wildfire risks, an alternative to open burning or landfill and their attendant air quality pollutants, and contribution to local economies. The focus on community scale operations includes a commitment to demonstrating how appropriately sized facilities can ensure ecosystem sustainability.

The California Energy Commission is working with IFWG to identify standards for biofuel utilization for its AB 118 Alternative and Renewable Fuel and Vehicle Technology Program (Task 3). CEC held a field trip to consider the sustainability of forestry treatments for fuels hazard and post-fire salvage as a source of woody biomass for fuel production.³² Preliminary “take home” messages from this workshop include: 1) fuel treatments can be very effective at reducing crown fire and tree mortality from wildfires and mimicking natural high frequency-low intensity wildfire behavior; 2) light thinning was not effective in reducing fuel loading hazards resulting in stand replacing fire effects and required substantial investments in artificial regeneration erosion prevention; 3) fuel treatments could provide significant amounts of biomass for fuels and energy but are not being utilized due to transportation costs; 4) burned areas which had fuel treatments recovered more quickly than untreated areas; 5) fuel treatments had minimal effects on soils and neutral or positive effects on herbaceous species diversity; 6) wildlife studies have been problematic and effects difficult to detect and quantify.³³

Land conversion continues to pose risks to forests and sequestration in California. According to the FRAP Assessment, the steady and long-term

³⁰ 2010 Regional Meeting: The Pacific Coast. 2010. Heinz Center and Pinchot Institute. <http://www.pinchot.org/gp/PacificRegionalMeeting>

³¹ [Forest Sustainability in the Development of Wood Bioenergy in the U.S.](#) 2010. The Heinz Center and Pinchot Institute for Conservation. http://www.heinzctr.org/Major_Reports_files/Pinchot_Heinz_Bioenergy%20Report_Final.pdf

³² CEC. Agenda for IFWG October 1 2010 Field Trip to Angora Fire. http://www.climatechange.ca.gov/forestry/meetings/2010-10-01_field_trip/2010-10-01_Field_Trip_Agenda.pdf

³³ Bill Kinney. Progress Report on IFWG Task 3. 2011. In draft.

contractions of the timber and ranching industries contribute to the propensity for conversion of working forests and rangelands.³⁴ This is accompanied by less infrastructure and decreasing ability for existing landowners to properly manage and restore wildlands. CAL FIRE identified the greatest potential losses to development in the Bay/Delta, Central Coast, Sierra, Sacramento, San Joaquin and South Coast bioregions (FRAP 2010).

Findings and Recommendations

The deliverables in the IFWG Task #2 Workplan based on input from the workshops and analysis by the Task 2 Workgroup are summarized as follows:

1) An evaluation, as feasible, of the capacity of existing forestry and regulatory framework and programs to ensure achievement of Scoping Plan targets,

Based on the input developed through workshops and assessments of current forest conditions, the Task 2 workgroup concludes that:

- Carbon stocks and sequestration rates on private and public lands indicate that carbon stocks and sequestration are increasing (FRAP 2010 Table 1.2.5). At current harvest levels it is likely that the 2020 forest sector targets will be met.
- Regulatory changes to the CEQA guidelines will provide adequate project level information on GHG emissions associated with project implementation
- Existing regulations requiring demonstration of long-term sustained yield on private ownerships greater than 50,000 acres indicate increasing levels of growing stock and growth which will translate to increasing levels of carbon storage and carbon sequestration rates through 2020.
- The USFS analysis indicates that net sequestration rates for federal lands will continue to increase at least until the middle of the century after which point wildfire, insects and disease could lead to conditions on federal lands where emissions exceed sequestration. (Goines and Nechodom 2009)
- There remain ongoing threats from wildfire related to anticipated changes in climate. While the magnitude and rate of these changes is not anticipated to significantly effect sequestration rates between now and 2020, consistent with the USFS analysis for sequestration trends on federal lands the FRAP 2010 assessment has identified reduced levels of carbon storage of up to 22% from current baselines by 2020 under dry climate assumptions (FRAP 2010 Table 3.7.3)
- FRAP has identified significant opportunities for increasing carbon sequestration rates through reforestation of currently poorly stocked areas or thinning to improve stand health (FRAP 2010 Tables 1.2.18 and tables 1.2.19)

³⁴ Op. Cit. CAL FIRE. 2010.

2) List of concerns and identified regulatory and program gaps

While current trends in harvesting, carbon stock growth and sequestration rates indicate that the existing regulatory structure is adequate to ensure attainment of the AB32 Forest Sector goals, a number of concerns were identified by stakeholders who participated in the Task 2 workshops. These concerns are described as follows:

- GHG effects of certain silvicultural methods such as clearcutting,
- Impacts of timber harvesting on soil carbon.
- Biomass operations, while currently limited in scope, could increase in pace and scale if market values for forest based biomass increase. Concerns over the sustainability of these activities and regulatory oversight of these activities on timberlands and forestlands needs further evaluation.
- Regulatory authorities for tree and biomass removal from non-timberlands is held by local governments and agencies. There remains a perception that local government approaches to vegetation manipulation vary widely and that there may be regulatory gaps which may need to be addressed. This area of potential regulatory gaps was not addressed by the Task #2 workgroup. It was, however, addressed extensively by the Board in 2004.
- Lack of funding support for practices outside of the timber harvesting regulatory system that will provide for increased carbon sequestration on forest lands. Stakeholders raised concerns about whether permitting exemptions for fire hazards or dead and dying trees provide adequate protection and GHG assurances.
- Questions were raised about staffing in various agencies to ensure adequate review of biomass projects if activity increases, especially for fish and wildlife impacts.
- Other concerns included air quality and health effects of local biomass plant emissions.

3) Recommendations, if needed, for amending regulations or improving program practices or procedures to ensure that CA forests achieve the Scoping Plan Target

Concerns raised regarding air quality health effects from burning of biomass were determined to not be within the regulatory authority of the BOF.

In general based on current trends carbon stock and given changes to existing statute, changes to existing Forest Practice regulations were not determined to be necessary based on the following changes which have been made to the Public Resources Code and CEQA guidelines:

- The Forest Practices Act was amended by the legislature effective January 1, 2011 to recognize role of forest carbon sequestration in meeting scoping plan goals. Changes included addition of PRC 4512.5 (a)-(e), PRC 4513 and PRC 4551. These additions to the Forest Practice Act require the BOF to ensure that rules and regulations that govern the harvesting of commercial forests meet AB 32 greenhouse gas reduction goals.

- Recently adopted 14 CCR 15064.4 of the CEQA guideline requires lead agencies to consider the significance of potential impacts from projects and develop model or methodologies for quantifying greenhouse gas emissions. The requirements of this CEQA guideline are applicable to harvest documents approved by CAL FIRE and CAL FIRE requires quantification of GHG emissions from proposed timber operations for each project which it reviews and approves. These regulations and guidelines would also apply to projects approved by local governments.

Concerns related to other issues raised warrant further analysis and are addressed in the following recommendations for longer term analysis, research, demonstration and monitoring.

4) Recommendations for longer term analysis, research, demonstration or monitoring of regulatory and other program effects on carbon sustainability

- Consistent with current efforts by ARB associated with Task 1, CAL FIRE, BOF, CEC and USFS should continue to work with ARB to improve the forest sector GHG inventory so it can be used to more accurately track and evaluate the capacity of programs and regulations to ensure sequestration.
- CAL FIRE and BOF should continue and, as appropriate, expand work with other agencies and consider stakeholder suggestions for improving reporting and tracking forest GHG fluxes, including:
 - Focused monitoring to ensure that current levels and trends in wildfire acreage burned and losses to insects are robust enough to recognize changes in rates or trends in emissions from these sources that could threaten achievement of AB32 Scoping Plan targets.
 - Development of tools for tracking acreage and volumes of biomass removed for fuel reduction and forest health treatments,
 - Improved harvesting trend analysis utilizing harvest data from California Board of Equalization (BOE) combined with GIS related data maintained by CAL FIRE to monitor trends in both timber harvesting and acres harvested from public and private timberlands.
- CAL FIRE, ARB, CEC, and USFS will conduct additional analysis to: a) project how biomass utilization costs and changing markets for energy, fuels and other products will likely affect biomass supply, landowner behavior and forest management; and b) consider the capacity of Forest Practices Act rules under scenarios of changing conditions to ensure sustainability and carbon sequestration at rates consistent with the Scoping Plan target.
- The Board of Forestry and Fire Protection and CAL FIRE should work with landowners, agencies and others to implement recommendations from the FRAP Assessment Strategy to protect existing forest carbon stocks from increased disturbance by restoring more resilient stand and landscape level forest conditions (see Appendix C):
 - Restore areas of high and medium priority fire-threatened landscapes with significant timber or biomass energy assets that have been damaged by past wildfires or forest pest outbreaks in the Klamath/North Coast, Modoc and Sierra bioregions. Bioregions with

smaller acreages of these priority areas include the South Coast and Bay/Delta bioregions.

- Improve resilience of forest and range lands to high-impact disturbance from fires and pests by thinning, prescribed burning and salvage where needed to increase tree vigor and stand health.
 - Improve sequestration by managing underperforming stands for increased vigor and growth
 - Implement strategies for improving forest conditions on private lands across California in collaboration with watershed and fire safe groups and cost-share or grant programs such as CFIP.
 - Maintain and improve the capacity of the wood products and range industries statewide to maintain working landscapes and infrastructure needed to support management.
 - Provide potential revenue streams to support working landscapes and reduce the costs of protective treatments, including promoting markets for sustainably using forest residues for electricity and biofuels
- Conduct longer term life cycle or equivalent analysis, as needed, to comply with AB 1504 (Statutes of 2009). Per AB 1504, PRC 4551(b)(1) to ensure that BOF rules and regulations governing timber harvesting under the range of permitted silvicultural systems will meet or exceed targets set for the Forest Sector in the AB32 Scoping plan. AB 1504 authorized funding for research to implement this requirement from AB 32 fee revenues, upon appropriation. CAL FIRE developed a preliminary work plan. See Appendix D.

APPENDIX A

IFWG Task 2 Work Plan

Revised by CAL FIRE, USFS 2-26-10

Task # 2 Objective:

Determine the effect of the State's existing forest and rangeland regulations (i.e., Sustained Yield Plans, Non Timber Management Plans, wildlife, water quality, erosion protection, etc.) and related programs on meeting the state's GHG goals, whether simple adjustments are needed, or whether more significant action is needed.

Deliverables

- An evaluation, as feasible, of the capacity of existing forest regulatory framework and programs to ensure achievement of Scoping Plan target
- List of concerns and identified regulatory and programmatic gaps,
- Recommendations, if needed, for amending regulations or improving program practices or procedures to ensure that CA forests achieve the Scoping Plan target
- Recommendations, as needed, for longer term analysis, research, demonstration or monitoring of regulatory and other programs' effects on carbon sustainability.

Steps

- 1) Develop a collaborative public involvement process that provides opportunities for stakeholder groups to participate in the development of IFWG findings and recommendations. Workgroup stakeholders should include a wide array of agencies, industry groups, land owners and NGOs covering the variety of interests.
- 2) CAL FIRE and USFS will conduct a meeting or workshop(s) to review and discuss latest information on current forest sequestration rates and sequestration trends.
 - a. Analysis of current forest carbon sequestration using updated FIA plot data as provided in Draft FRAP Assessment
 - b. Information on potential sequestration for short-term (2020) and longer term, including:
 1. Potential FRAP analyses or projections of sequestration potential
 2. Review of CAL FIRE Option A plans
 3. USFS projections of long-term trends and risks

- c. Work group will work with stakeholders to consider other sources of information related to forest sector sequestration predictions for 2020.
- 3) Work group will review and discuss information about risks to carbon storage and risks of emissions, using analyses from FRAP Forest and Rangeland Assessment Program. This will include risks to harvest, wildfire, conversion and disease and insects.
- 4) Work group will review current regulations and program procedures for maintaining growth, yield and net carbon sequestration
 - a. CAL FIRE will do presentation on Forest Practices Act rules and forestry assistance programs for maintaining and enhancing carbon stocks, e.g., Timber Harvesting Plan process, sustained yield regulations, silviculture rules and post harvest stocking requirements, timberland conversion permitting, reforestation and forest improvement activities.
 - b. Data collection and reporting practices associated with these programs will also be reviewed.
 - c. USFS will review federal forest regulations and project development process, e.g. NFMA and Forest Plans, if desired
- 5) Work group will identify information gaps or concerns about capacity of regulatory and other fire or forestry assistance programs to achieve Scoping Plan 2020 target, plus potential effects of other institutions and sectors on Forest sector ability to achieve target.
 - a. Work group will consider opportunities and barriers to achieving AB 32 target
 - b. Discussion will consider how markets and investment climate affects forest sector actions
- 6) Based on steps above, work group will evaluate adequacy of programs for achieving Scoping Plan 2020 target of GHG sustainability and will recommend changes to programs, if needed, to ensure GHG sustainability, including consideration of inventory improvements from Task #1, program tracking and administration, silvicultural practices, regulations, etc. This information can be used as a starting point for IFWG Task 3 consideration of sustainable utilization of forest biomass for bioenergy purposes.
- 7) Work group will decide whether additional research, analysis, demonstrations, workshops or monitoring, is needed to fill information/program gaps, and will develop a work plan with clear objectives, timeline and resources.

APPENDIX B

Excerpts from California Forests and Rangeland Resource Assessment (CAL FIRE 2010)

Chapter 1.2 Sustainable Forests and Rangelands

The concept of “working landscapes” was developed to encompass the idea that lands used for commodity production also produce crucial ecosystem goods and services, and that future demands make it essential that these systems are managed for joint production of ecosystem services and food and fiber (Huntsinger and Sayre 2007).

The sustainability of working landscapes broadly has many environmental, economic and social dimensions. The topic is addressed by examining a variety of issues under land use and land cover impacts, cultural resources, pesticide use, the condition of the forests and rangelands, their associated economic sectors, current and developing policy, and assistance to landowners and communities.

Overview of Management Context

Management activities (or lack of them) can affect (positive, neutral or negative) land cover condition, forest health, soils and protection of special sites or qualities, such as habitat, scenic views or cultural resources. All of these things are elements that relate to overall sustainability.

In the case of forest management, possible impacts on land cover come from such things as site preparation, harvesting, regeneration activities (including application of herbicides), fuel reduction and fire suppression. Range effects can come from grazing intensity and other practices, water pollution from livestock and related factors. In the case of recreation, site disturbance and compaction can take place. Other impacts can spread exotic species and cause loss of or damage to historical and cultural resources.

There are many laws, policies and programs (both regulatory and non-regulatory) across a number of agencies that address conditions and impacts of land uses on forests and rangelands. The overarching laws are federal and state statutes that deal with clean air, clean water and endangered species. There are other federal and state laws that deal with development of plans or permits and emphasize advance public outreach, evaluation of project design, possible impacts and their mitigation.

Federally-owned forests and rangelands are managed by agencies such as the U.S. Forest Service, Bureau of Land Management, National Park Service, and the Department of Defense (DOD). The largest landowner in California is the U.S. Forest Service, whose Region 5 manages 18 national forests and one

grassland comprising 20.4 million acres. The Bureau of Land Management (BLM) and National Park Service are the next largest at 14.6 and 7.2 million acres respectively (out of a total state area of 100 million acres, 42% is federally owned). Each of the agencies operates under numerous federal laws, regulations and policies that require extensive planning, consideration of wide-ranging impacts, and application of sound management practices with evaluation of results.

Focuses of the new federal administration include national forest planning, budgeting for fire protection, biomass and renewable energy supply and state and private forestry assessment. Key areas of concern for the U.S. Forest Service include clean and abundant water, wildlife habitat, recreation and biomass opportunities for local economies and climate change mitigation and adaptation. Restoration, roadless area protection, the loss of private forests to development and fragmentation and the need to keep forest ownership and stewardship economically viable are areas of emphasis (Vilsack, 2009).

Approximately 14 million acres in California are designated as wilderness. Major additions were made in 2006 and 2009. In 2006, President Bush approved a wilderness bill focused on 273,000 acres in Northern California. President Obama signed three bills in 2009 that designated approximately 700,000 additional acres as wilderness in Riverside, Tulare, Mono, Inyo, San Bernardino and Los Angeles Counties. Significant portions were in reserved status already. Wild and scenic river protection was a part of both efforts.

On non-federal forestlands in California, the basic regulatory structure is delineated in the California Forest Practice Act. Detailed forest practice rules have been developed that utilize management practices required under the rules or requested by reviewing agencies. Permits must be obtained based on plans prepared by licensed professional foresters. These documents cover planning, operational and post-harvest (such as reforestation) aspects of harvesting. They are reviewed by other state agencies such as the Department of Fish and Game (DFG), the California Geological Survey and Regional Water Quality Control Boards (RWQCBs). Both DFG and the RWQCBs have additional permit authorities that cover areas of concern to these agencies.

Management of non-federal rangelands is less regulatory. For example, water quality is largely addressed through education and voluntary practices. Information sharing and monitoring occurs through the California Rangeland Water Quality Management Plan. This was developed in collaboration with state and federal agencies, cooperative extension and landowners to provide for development and implementation of ranch water quality plans on a voluntary basis (SWRCB, 1995).

Forest and Rangeland Management Impacts on Water Quality and Wildlife

Based on biotic indicators, a majority of the state's waters are in fair or good condition. Impacts related to rangeland or silviculture sources, as indicated by the 303d list, have not changed significantly from 2002 to 2006. The percentage of impaired streams that have rangeland grazing or silviculture as a factor is highest in the Lahontan and North Coast regions. However, the total impaired stream miles with these factors were greatest in the North Coast region. Cattle and sheep grazing in high elevation areas of the Sierras has been criticized for polluting lakes and streams with suggestions to restrict grazing to lower elevations (Knudson, 2010).

Data collected for the MSG (BOF Monitoring Study Group) found that overall the rate of compliance with forest practice rules designed to protect water quality and aquatic habitat is generally high, and the rules are highly effective in preventing erosion, sedimentation and sediment transport to channels when properly implemented. There are specific areas where improvements in implementation or effectiveness could be made and these are enumerated with specific recommendations. In the case of water quality monitoring on national forest lands, results show that while some improvements are necessary, the program performed reasonably well in protecting water quality on national forest lands in California (Brandow et al., 2006). Effects classified as elevated were typically caused by lack of or inadequate implementation of good practices and most elevated effects were related to engineering practices. Roads, and in particular stream crossings, were found to be the most problematic.

Forestland Condition

Ownership and Net Volume

The basic source of information on forests and woodlands is the Forest Inventory and Analysis Program (FIA) of the U.S. Forest Service. This program has been fundamentally restructured and this complicates decadal trend analysis.

However, FIA has published information (Christensen et al., 2008) on the first five years of annual plot measurements done under the restructure.

Timberland is a subset of forestland and is defined as lands capable of producing in excess of 20 cubic feet/acre/year at its maximum production. Non-industrial private forestland is about two-thirds of the private forestland, or about 8.5 million acres.

Adding two additional years of plots in the 10-year inventory cycle of FIA (Forest Inventory Data Online (FIDO)) caused a revised estimate of net cubic volume of 99,203 million cubic feet from 95,547 million cubic feet (Christensen et al., 2008). Using the online FIDO query with two more years of data, the standard error improved from 2.1 percent of the estimate to 1.7 percent. About two-thirds of the volume is on public lands, mostly federal.

Estimated area of forestland, by owner class and forestland status, 2001–2007 (acres in thousands)

Owner Class	Unreserved Forests			Reserved Forests	Total
	Timberland	Other Forest	Total		
National Forest	9,794	2,516	12,310	3,611	15,921
National Parks	0	0	0	1,312	1,312
BLM	471	892	1,363	277	1,640
Other Federal	44	143	187	111	298
Total Federal	10,309	3,551	13,860	5,311	19,171
State	138	118	202	509	711
Local	110	156	266	108	374
Total Private	8,780	4,351	13,131	0	13,131
All Owners	19,337	8,122	27,459	5,928	33,387

Data Source: USFS Forest Inventory and Analysis, 2001–2007

Net tree volume (in millions of cubic feet) on forestland by ownership and reserve status

Ownership	Not	Reserve	Total
National Forest	41,817	13,041	54,858
National Parks	0	5,907	5,907
BLM	1,308	196	1,504
Other Federal	116	355	471
Total Federal	43,241	19,499	62,740
State	898	3,532	4,429
Local (county, municipal, etc)	579	388	967
Total Private	31,066	0	31,066
All Owners	75,784	23,419	99,203

Data Source: USFS Forest Inventory and Analysis, 2001–2007

Estimated Carbon

A 100-year projection of alternative carbon inventory scenarios, assuming various management inputs, was conducted for U.S. Forest Service lands in California (Goines and Nechodom, 2009). Results from this report provide estimates of expected and potential carbon sequestration and storage on U.S. Forest Service lands in California. The carbon analysis conducted on Forest Service lands in California (Goines and Nechodom, 2009) estimates that in 2007, 20.2 million acres held nearly 620 million tons of carbon in live tree biomass. The standing stocks in 2100 could be lower or higher than current levels depending on policy alternatives. In most cases there is active sequestration over the next 50 years before a decline to near current levels.

To estimate the current carbon storage and sequestration on forestlands in California, the following analysis was conducted (Robards, 2010). FIA plots (USFS, 2008) from seven years of annual inventories (2001–2007) were processed to calculate current carbon storage and sequestration on all

forestlands, both private and public, and private non-reserved timberlands. The four variants of the Forest Vegetation Simulator (FVS) were used to estimate growth and mortality of plots (Ritchie, 1999). The plots were grown for the standard 10-year increment. Carbon storage and change were calculated for live tree, above and below ground portions for trees greater than or equal to five inches diameter at breast height using the FIA regional volume and biomass functions (USFS, 2009a and 2009b). While this analysis contains many of the key elements, this analysis is not a full forestry sector inventory.

Emissions were estimated for mortality, wildfire, and harvest. Wildfire emission estimates were based on California Air Resources Board (ARB) emissions estimates that were prorated to private/public and forest/non-forest categories using 10-year fire history data. A CO₂/CO ratio of 13 was used (Klaus Scott, personal communication). Harvest emissions from bole wood were estimated from 10-year average Board of Equalization data and U.S. Department of Energy (DOE) 1605(b) conversion factors. Non-merchantable emissions were estimated using harvest efficiency along with top, stump and root relationships to the bole (Cairns et al., 1997; Christensen et al., 2008). Storage due to wood products in-use and landfill were calculated based on the 10-year average storage from the DOE 1605(b) emission inventory technical guidelines for voluntary reporting of greenhouse gases (DOE, 2007 Part I).

The Robards analysis is an inventory compilation and modeling exercise with unknown error. Christensen et al. (2008) estimated the aboveground live tree carbon per acre as 33.7 tons (30.6 metric tons). The estimate of aboveground live tree carbon from the Robards analysis is 31.1 metric tons of carbon per acre, which compares favorably as a check. Hudiburg et al. (2009) estimate average stocks of 6.5 to 19 kilograms per square meter across Northern California and Oregon, which equates to 96.5 to 282.2 metric tons CO₂e per acre. This estimate brackets the values in this report. The FVS growth models used in this analysis were developed primarily from data on national forests and are used for long-term planning on national forests. Intensively managed forests, as found on many private timberlands, will likely have growth underestimated and mortality overestimated. Coast redwood, which is primarily privately owned, is missing from FVS; the other softwoods category was used as a surrogate. Therefore, the private lands estimates should be considered a lower range of possible results, particularly for the coast redwood region and for plantations.

Carbon sequestration analysis results for all forestlands (32,114,317 acres)

Source	Type	Carbon (metric tons)	CO2e (metric tons)
Growth	Storage	-16,367,285	-60,067,936
Model Mortality	Emission	5,455,351	20,021,137
Wildfire	Emission	1,719,915	6,312,087
Harvest (merch)*	Emission	565,315	2,074,706
Harvest (non-merch)	Emission	791,776	2,905,819
WP (in-use)	Pool	-389,436	-1,429,231
WP (landfill)	Pool	-48,796	-179,081
Net		-8,273,161	-30,362,499
*Reduced by 22.8% for salvage (10-yr avg) duplication			

Carbon sequestration analysis results for public forestlands (19,467,566 acres)

Source	Type	Carbon (metric tons)	CO2e (metric tons)
Growth	Storage	-12,660,007	-46,462,226
Model Mortality	Emission	4,319,121	15,851,175
Wildfire	Emission	1,415,436	5,194,651
Harvest (merch)*	Emission	40,703	149,379
Harvest (non-merch)	Emission	57,008	209,219
WP (in-use)	Pool	-28,039	-102,905
WP (landfill)	Pool	-3,513	-12,894
Net		-6,859,292	-25,173,600
*Reduced by 22.8% for salvage (10-year average) duplication			

Carbon sequestration analysis results for private forestlands (12,646,761 acres)

Source	Type	Carbon (metric tons)	CO2e (metric tons)
Growth	Storage	-3,708,104	-13,608,743
Model Mortality	Emission	1,136,233	4,169,977
Wildfire	Emission	304,478	1,117,436
Harvest (merch)*	Emission	524,612	1,925,327
Harvest (non-merch)	Emission	734,768	2,696,600
WP (in-use)	Pool	-361,397	-1,326,326
WP (landfill)	Pool	-45,283	-166,188
Net		-1,414,691	-5,191,917
*Reduced by 22.8% for salvage (10-year average) duplication			

Carbon sequestration analysis results for private timberlands (7,647,009 acres)

Source	Type	Carbon (metric tons)	CO2e (metric tons)
Growth	Storage	-3,603,556	-13,225,049
Model Mortality	Emission	1,010,508	3,708,564
Wildfire	Emission	184,106	675,670
Harvest (merch)*	Emission	524,612	1,925,327
Harvest (non-merch)	Emission	734,768	2,696,600
WP (in-use)	Pool	-361,397	-1,326,326
WP (landfill)	Pool	-45,283	-166,188
Net		-1,556,240	-5,711,402
*Reduced by 22.8% for salvage (10-year average) duplication			

Total live tree stocks and estimated annual change from tree growth and mortality

Landbase	Acres	Stocks				Change, Net of Mortality			
		CO2e (metric tons)	Cubic Feet (thousands)	Board Feet (thousands)	Number of Trees	CO2e (metric tons)	Cubic Feet (thousands)	Board Feet (thousands)	Number of Trees
All Forestlands	32,114,317	5,099,162,048	113,695,755	447,709,621	10,058,521,955	40,046,799	1,419,806	5,764,470	-58,328,612
Public Forestland	19,467,566	3,343,515,541	76,368,749	340,794,682	5,685,834,310	30,611,051	751,107	3,438,690	-38,089,971
Private Forestland	12,646,761	1,755,647,124	37,327,502	106,914,068	4,372,687,646	9,438,766	668,726	2,325,853	-20,237,568
Private Timberland	7,647,009	1,418,463,058	31,054,447	103,118,272	4,364,675,374	9,516,486	591,411	2,242,743	-17,094,787

Per acre live tree stocks and estimated annual change from tree growth and mortality

Landbase	Stocks					Change, Net of Mortality				
	CO2e (metric tons)	Cubic Feet (thousands)	Board Feet (thousands)	Number of Trees	Stand Density Index	CO2e (metric tons)	Cubic Feet (thousands)	Board Feet (thousands)	Number of Trees	Stand Density Index
All Forestlands	158.8	3.5	13.9	313.2	214.1	1.247	0.044	0.179	-1.816	2.422
Public Forestland	171.7	3.9	17.5	292.1	225.1	1.572	0.039	0.177	-1.957	2.015
Private Forestland	138.8	3	8.5	345.8	197.1	0.746	0.053	0.184	-1.6	3.05
Private Timberland	185.5	4.1	13.5	570.8	258	1.244	0.077	0.293	-2.235	4.189

The differences in the public and private lands may be a function of stand age as well as productivity. Hudiburg et al. (2009) showed that there are marked differences in stand age distributions, with private lands having substantially younger stands. A recent U.S. Forest Service analysis (Goines and Nechodom, 2009) showed that while national forests are currently sequestering a substantial amount of carbon, there are long-term risks associated with storage given

disturbance and management assumptions. Consideration should be given to both the amounts of carbon sequestered and the probability of long-term storage. Potential long-term sustainable carbon storage on private lands needs further analysis. Hudiburg et al. (2009) estimates that total landscape stocks in Oregon and Northern California could theoretically be increased by 46 percent. The relative amount of current stocks to long-term sustainable stocks is of considerable policy interest and needs further study.

Growth and Harvest

One key indicator of forest sustainability is the growing stock and removals relative to growth over time. Estimates of growth, mortality and removal based on FIA data collected from 2001 to 2005 showed that growth was statistically the same or exceeded mortality and removals for public and private landowner classes (Christensen et al., 2008). The largest increase in inventory was on national forest lands although on the average they tend to be less productive. Improved estimates of changes in growth, mortality and removal will be available in the next few years as re-measurements of plots are completed and analyzed.

While only a partial measure, another possible indicator is the amount and type of timber harvesting occurring. Relatively little harvesting has taken place on federal lands. The groupings of silviculture are done to be consistent with the classifications in the California Forest Practice Rules. Counties with total harvesting over three percent included Glenn, Modoc and Sierra Counties, which had mostly intermediate harvest types in aggregate. Overall, the average annual harvest covered 1.64 percent of private timberland acres with even-aged, intermediate and uneven-aged silvicultural practices accounting for 0.71, 0.35 and 0.58 percent respectively. 1.64 percent harvest coverage approximately equates to an average 61-year return interval.

Acres and percent of silvicultural type by county for private timberland harvest averaged over 10 years (2000–2009).

County	Acres of Timberland					Percent of			
	Even-Aged	Intermediate	Uneven-Aged	Total	Private	Even-Aged	Inter-mediate	Uneven-Aged	Total
Alpine		10	18	28	11,678	0.00	0.09	0.15	0.24
Amador	669	243	176	1,088	120,344	0.56	0.20	0.15	0.90
Butte	2,404	677	441	3,523	265,310	0.91	0.26	0.17	1.33
Calaveras	1,373	350	818	2,541	210,304	0.65	0.17	0.39	1.21
Del Norte	880	216	234	1,329	106,023	0.83	0.20	0.22	1.25
El Dorado	3,618	863	732	5,213	369,048	0.98	0.23	0.20	1.41
Fresno		110	1,683	1,792	95,663	0.00	0.11	1.76	1.87
Glenn	320		16	336	5,381	5.95	0.00	0.30	6.24
Humboldt	8,965	2,611	4,226	15,802	1,234,885	0.73	0.21	0.34	1.28
Kern		267	767	1,034	149,044	0.00	0.18	0.51	0.69
Lake	278	104	282	664	100,104	0.28	0.10	0.28	0.66
Lassen	4,262	1,681	5,001	10,944	369,109	1.15	0.46	1.35	2.97
Madera		10	164	174	88,006	0.00	0.01	0.19	0.20
Marin	200	93	372	664	35,850	0.56	0.26	1.04	1.85
Mendocino	6,031	2,611	7,463	16,105	1,408,582	0.43	0.19	0.53	1.14
Modoc	2,320	5,732	2,755	10,807	224,758	1.03	2.55	1.23	4.81
Napa	2	64	29	95	108,598	0.00	0.06	0.03	0.09
Nevada	1,268	766	1,553	3,586	288,256	0.44	0.27	0.54	1.24
Placer	1,619	1,193	1,457	4,269	239,259	0.68	0.50	0.61	1.78
Plumas	1,301	1,600	2,463	5,364	309,628	0.42	0.52	0.80	1.73
San Bernardino		16		16	48,325	0.00	0.03	0.00	0.03
San Mateo		5	496	501	40,342	0.00	0.01	1.23	1.24
Santa Clara			261	261	43,223	0.00	0.00	0.60	0.60
Santa Cruz		15	1,047	1,062	114,380	0.00	0.01	0.92	0.93
Shasta	9,295	4,026	8,982	22,304	832,702	1.12	0.48	1.08	2.68
Sierra	834	1,077	1,746	3,657	110,625	0.75	0.97	1.58	3.31
Siskiyou	8,867	5,483	5,431	19,780	836,828	1.06	0.66	0.65	2.36
Sonoma	399	213	828	1,440	433,352	0.09	0.05	0.19	0.33
Tehama	3,400	575	1,407	5,382	259,027	1.31	0.22	0.54	2.08
Trinity	5,414	760	871	7,045	428,952	1.26	0.18	0.20	1.64
Tulare		227	182	409	94,992	0.00	0.24	0.19	0.43
Tuolumne	934	407	1,010	2,351	159,905	0.58	0.25	0.63	1.47
Yuba	955	576	575	2,107	85,066	1.12	0.68	0.68	2.48
Total	65,608	32,580	53,487	151,675	9,227,549	0.71	0.35	0.58	1.64

Data Source: CAL FIRE Forest Practice Database, 2009

Stand Condition

The 2001–2007 FIA data for California was queried (FIDO, 2010) to produce a graph of forest biomass by landowner and stand age classes and a table on snag density by landowner and diameter classes. This information is presented in a statewide aggregated form across reserve status, ecological types and management history, which is useful for general use and is not specific to individual ownership.

Private forestlands have an age distribution that is generally younger than public lands.

This is a function of historic logging, forest types, productivity and current management objectives. Correlation of stand structural elements and stand age

is expected, resulting in lower densities in more intensively managed forests. Private forestlands have on average about half the snag density as Forest Service lands. The relative distribution of snags across tree sizes is similar across all ownership categories. Snags and other dead wood perform as both an asset (e.g., nutrient cycling, habitat) and as a risk factor (e.g., fuel, insect brood material) to a particular stand. Reconciling these competing functions with landowner objectives presents a management and regulatory challenge at the landscape planning and project levels.

Condition of the Forest Products Sector

California's forests are as diverse as their ecosystems. These forests include coastal temperate rainforests, oak savannas, mixed conifer, high elevation fir, dry pine, and unique communities including pigmy forests on coastal terraces, giant sequoias in the Sierras (the largest trees on earth), subalpine bristlecone pine (the world's oldest trees), and coast redwoods (the world's tallest trees). The forests of California are relied upon for a vast array of ecological services and commodities. California is one of the top wood products producing states (Adams et al., 2006). Non-reserved private and public forestlands are about equally represented at 13 million acres each. Most of the wood produced from California forestlands, however, is from private lands.

California forests produce relatively high quality softwood products, such as dimensional lumber, molding and decking. Many of the large forestland ownerships are part of integrated operations that include sawmills and sometimes secondary manufacturing, although timberlands may be held by separate companies than mills. The national trend of the disposition of timberlands from formerly integrated forest products companies is not as common in California. Large industrial timberland ownership in California is concentrated in long-term family oriented corporations, which appears beneficial to long-term forest and rural economic sustainability. The concentration of milling facilities and general reduction in production capacity, however, will continue to limit the economic feasibility of operations over increasing geographic areas of the state. This may in turn affect the ability to conduct beneficial treatments, increasing risk over landscapes. Revenue reductions to landowners may impact working landscapes by increasing the economic attractiveness, or necessity, of alternative uses – conversion to non-forest cover.

Private non-corporate forest landowners control a quarter of the state's timberlands. The size of these properties makes them particularly sensitive to costs and geographically dependent on local revenue opportunities. The stabilization of the existing wood products infrastructure, increased opportunities from emerging ecosystem services markets, regulatory compliance costs, and estate planning factors such as the federal estate tax, will all affect the ability of these owners to retain their lands as working landscapes. Woodlands, in particular, are affected by this class of landowner and may intersect both forest and rangeland ownerships.

Statewide, the best estimates are that standing stocks of trees are stable or increasing. Estimates are problematic due to changes in design of the national FIA inventory, but will improve in time. Carbon stock change estimates indicate that the AB32 Scoping Plan 2020 objective of no net loss in sequestration, which is estimated to be five million metric tons of CO₂e a year, will likely be met and exceeded. This assumes that current sequestration rates will continue for the next ten years and that no catastrophic changes occur in that time frame.

APPENDIX C
EXCERPTS FROM CALIFORNIA FOREST AND RANGELANDS: 2010
STRATEGY REPORT

List of concerns and identified regulatory and programmatic gaps

The following list was compiled after a review by the Board and staff of the Strategy Report.

- High priority landscapes with rangeland productivity at risk from wildfire were found primarily in the Bay/Delta, Central Coast, Sierra and South Coast bioregions. Bioregions with smaller acreages of high priority landscapes or extensive areas of medium priority included the Klamath/North Coast, Modoc and Sacramento Valley bioregions.
- Regarding restoration, extensive areas of high and medium priority landscapes representing areas with significant timber or biomass energy assets that have been damaged by past wildfires or forest pest outbreaks are found in the Klamath/North Coast, Modoc and Sierra bioregions. Bioregions with smaller acreages of these priority areas include the South Coast and Bay/Delta bioregions.
- A clear opportunity exists to implement strategies for improving forest conditions across California. The costs and benefits are variable, but competing for resources to implement stand improvement projects often benefits from both matching resources and economies of scale. Opportunities to tie projects to landscape plans are currently limited, especially across public/private boundaries. Examples of successful landowner aggregation are with existing watershed and firesafe groups and CFIP projects that aggregate landowners with less than 20 acres.
- Significant reductions have recently been occurring in sawmills, processing facilities, loggers, livestock, and associated supporting infrastructure. Entire areas of California lose resource management options when activity falls below critical levels locally. Statewide product demand is often not reduced concomitant with in-state production, which increases imports and reduces environmental impact controls. There is a need to maintain and improve the capacity of the wood products and range industries statewide.
- Climate Change – Strategies to address underperforming stands and carbon sequestration are addressed in the climate change section. While the focus there is on improving carbon stocks and sequestration, timber and wildlife habitat may also be improved by the same practices.

- Plant, Wildlife and Fish Habitat Protection – The plant, wildlife and fish habitat protection strategy is highly correlated with preserving working landscapes.
- Wildfire and Forest Pests Prevention and Restoration – Improving the resilience of forest and range lands to high-impact disturbance from fires and pests will have direct benefits to landowners in avoiding investment losses.
- Emerging markets – Provide potential revenue streams to support working landscapes and reduce the costs of protective treatments.

Recommendations, as needed, for longer term analysis, research, demonstration or monitoring of regulatory and other programs' effects on carbon sustainability.

- Rigorously evaluate the full costs and benefits of new legislation and regulation to avoid unreasonable additional costs to landowners and producers. In particular, the environmental and economic effects of shifting supply outside California should be quantified.
 - Support proper management to protect and enhance the multiple values of California's urban and community forests and forests in the wildland/urban interface.
 - Maintain tax-related zoning, encourage county governments to support timber production through Timber Production Zoning.
 - Support livestock and other range-based enterprises by preserving high quality rangeland through the Williamson Act or other local zoning.
 - Encourage forest landowners to manage their forests in a manner that ensures long-term wood volume growth in California equals or exceeds rates of timber harvest and mortality across all ownerships.
- Address rising consumption and statewide limitations on California commodity output, incentives for private production of ecosystem services, maintaining large landholdings in resource industries and weak economies in local communities
 - Broaden remuneration methods to landowners for non-commodity products that complement commodity production.
 - By policy, recognize the overall role of private landowners in producing ecosystem services.
 - Develop watershed-scale approaches to permits and restoration activities that reward landowners for attaining socially desired future conditions.
 - Refine trading and credit system for habitat provision, pollution reduction, and carbon sequestration.
 - Track the levels of management that will be permitted on federal lands and how they relate to overall resource supplies and protection strategies.
 - Strengthen monitoring and adaptive management approaches for individual parcels as well as larger landscapes.

- Address policy options for levels of regulatory oversight and policy integration as well as conflicts over forest and rangeland management practices
 - Conduct an analysis of the impact of overlapping mandates and review processes to create an efficient regulatory structure.
 - Connect policies for investment in energy and carbon sequestration to landowner incentives.
- Increase the capacity to provide incentives to forest and range landowners.
 - Develop carbon protocols for avoided wildfire emissions and biomass utilization that will make fuel reduction activities for restoring forest health eligible for offsets or other carbon-related funding.

APPENDIX D

WORK PLAN FOR RESEARCH SUPPORTING AB 1504

PRC 4551(b)(1) requires the BOF to ensure that its rules and regulations governing the harvesting of commercial tree species consider the capacity of forests to meet or exceed targets set for the Forest Sector in the AB32 Scoping plan.

The Forest Sector is unique in that it is the only sector in the Scoping Plan that currently is a net GHG sink. Currently forest and range landscapes are believed to remove (sequester) more CO₂ from the atmosphere to meet the physiological needs of the plants on those landscapes than are emitted from other elements of the Forest Sector. These benefits from forest sequestration, which help slow climate change, are at risk themselves to climate change. Climate science predicts loss of conifer forest cover as a result of forest regeneration failures and stand mortality caused by temperature increases, drought stress, possible increases in insects and disease, and dramatic increases in wildfires. Thus there is a critical need to measure and monitor climate change effects on forest stands, sequestration and emission processes, and management effects on these processes. Currently, there is limited investment in statewide monitoring of forest carbon that is needed to support important policy and management decisions.

AB 1504 directs the BOF to ensure that its regulations governing commercial timber harvesting activities consider the capacity of those forest resources to meet AB32 scoping plan targets. Of the roughly 33 million acres of forest lands in California, the BOF has authority for protecting the 14 million acres of state and privately owned forests and woodland. One of the means for doing this is regulation of commercial timber operations (harvest of wood products for sale or barter on lands supporting tree species that have been declared “commercial”). This currently occurs on about 9 million acres of private timberland (land capable of producing 20 cu feet or more per year of commercial timber species and not excluded from harvest due to land management status). Oak woodlands are not currently regulated.

The analysis of the capacity of state and private forest lands and the rules that govern them to sustain carbon sequestration services is consistent with the IFWG Task 2 objective to:

“Determine the effect of the State’s existing forest and rangeland regulations (i.e., Sustained Yield Plans, Non Timber Management Plans, wildlife, water quality, erosion protection, etc.) and related programs on meeting the state’s GHG goals, whether simple adjustments are needed, or whether more significant action is needed.”

AB 1504 will assist IFWG to be responsive to questions regarding the current adequacy of the BOF’s harvesting rules for carbon sustainability as it applies to programs administered by other agencies, such as CEC’s Alternative and Renewable Fuel and Technology Program (AB 118) and Renewable Portfolio

Standard (RPS), and ARB's Low Carbon Fuel Standard, Cap and Trade, Renewable Portfolio Standard and Renewable Electricity Standard (RES) programs.

Understanding and measurement of forest carbon pools, carbon flux, and net sequestration trends are critical to analyzing the capacity of California forests and of the Forest Practice rules and regulations to meet the Forest Sector CO₂ reduction target. Data collection, scientific protocols and analytical methodologies for these purposes are still evolving.

The USFS Pacific Northwest Research Station's Forest Inventory and Assessment Program (FIA) measures forest stand characteristics statewide on private and public lands, and estimates standing timber inventories, growth, mortality from pests, wildfire and other causes, and other forest carbon pools. The USFS recently revised its FIA methodology to increase information and consistency. FIA is expected to provide statistically robust data about forest growth and carbon sequestration by 2016.

The activities mentioned here will help bring together efforts to support objectives of AB 1504 to analyze the effects of forest rules and regulations, and to support the Scoping Plan objective for the BOF and CAL FIRE to understand the fate of sequestered forest carbon and to determine and implement needed forest actions to achieve or surpass the Forest Sector GHG reduction target,

Specific tasks would include:

1. Scoping out a work plan with stakeholders and IFWG participants to:

- Identify the regulations and practices that could significantly affect carbon sequestration processes and trends
- Clarify the temporal framework for analysis, including the effects of rules and regulations on achieving the short-term 2020 AB 32 target and the longer term 2050 target identified by Governor's Executive Order S-03-05 and also included in the Scoping Plan
- Clarify the appropriate spatial framework, such as forest types or geographic areas associated with different treatments and activities
- Review, summarize and work with stakeholders to select best existing data, analytical methods, forest growth models, and climate models for use in this analysis
- Potential data and modeling needs; review approaches for data analysis
- Identify research needs and information gaps
- Provide for peer review
- Ensure that the information will inform other agency programs.

- Recommend approaches/options for life cycle analysis and other types of data analysis given both time and budget constraints.
2. Select contractor for technical work and conduct GHG sequestration and life cycle analyses for the major California forest types based on species and harvesting type. Potential work includes:
 - Select or develop accurate data on growth and yield for commercial forest species
 - i) Most accurate inventory and growth data
 - ii) Appropriate information on forest management and regulation activities and their effect on forest carbon
 - iii) Utilization information, including mill log input/outputs from California manufacturing facilities to determine the end use of the material (short and long lived products)
 - iv) Information on utilization of tops, limbs, underbrush, and ladder fuels, including bio-energy use
 - Calibrate existing models, or develop or new models necessary to quantify appropriate carbon pools and management impacts to those pools and support a life cycle analysis that models changes in carbon pools and sequestration over time.
 - i) Run model(s) and validate results for a pilot project area.
 - ii) Make results available for peer review (e.g. agency and UC researchers)
 - Determine appropriate ranges of management and disturbance scenarios for use in analysis
 - Incorporate climate change effects for analysis of long-term effects, including wildfire risk
 - Conduct full life cycle analysis of forest growth, harvests, product utilization, decomposition of on-site materials and off-site forest products, regeneration, and disturbance regimes for near and long-term scenarios
 3. Peer-review of results and publication of results, including a series of California based life cycle analyses for the forest types and management scenarios.
 4. Collaborate with ARB, USFS, and other interested stakeholders on the development of methods to track and analyze forest based GHG emissions and carbon sequestration, and forest management and regulated activities and their effects on carbon sequestration as it relates to the Forest Sector target.